

Chapparal

Bolt Failure on a Racing Automobile

At a recent luncheon meeting at which he was a guest speaker, Mr. Jim Hall was asked to comment on some bolt failures on his new Chaparral 2E automobiles which had been reported in the press. A number of responsible publications had reported that during some practice runs prior to the Bridgehampton Grand Prix, similar bolt failures had occurred on two of Mr. Hall's cars. According to one report¹, a bolt fell off one of the car's spoilers, into the bodywork, and onto a rear tire causing it to blow, after which the car went off the race course. This article also reported that soon afterwards, the same bolt failure occurred in a second Chaparral and that it went off the track at the same spot as the first.

¹ Competition Press, Vol. 16, No. 40, Oct. 8, 1966 (Exhibit 1)

The Chaparral

The Chaparral is a custom racing machine designed particularly for Grand Prix style sports car races. It is revolutionary in that it is the first and only consistently successful competition automobile to make use of an automatic transmission. Perhaps its most noticeable feature is the distinguishing wing (spoiler) mounted on the rear deck of the car. Early models had the "spoiler" mounted on the automobile chassis close to the rear deck. The newer Chaparral 2E, however, has a wing mounted on struts approximately two feet above the highest point on the car. The angle of attack of the wing is controlled by a foot pedal in the driver's compartment and by changing this angle, the driver can put more force on the rear wheels of the car, increasing the car's cornering ability over that of its competitors. The wing is also used to increase aerodynamic drag of vehicle for braking.

For lateral support of the wing assembly, Mr. Hall had provided a stabilizing side link attaching the left wing strut to a rear chassis bulkhead. Because he wanted to avoid disturbing the exhaust duct on that side of the car, Mr. Hall put a bend, as shown in Exhibit 2, in the stabilizing link so that it would miss the duct.

Mr. Hall pointed out to those at the meeting that the failure the press referred to on each of his cars was not a bolt failure, but was a fracture of the rod end where the stabilizing link shown in Exhibits 2a and 2b is joined to one end of a ball joint which, in turn, is joined to the wing strut. What actually happened was that these rod ends broke and the strut fell against the rear wheel causing the reported blowouts. The stabilizing link was connected to the wing strut by a ball and socket joint, one end of the joint being rigidly attached to the link. The joint was screwed into the link and held in place by means of a lock nut. The fracture, which appeared to be a fatigue failure, was located on the threaded shaft of the joint where the lock nut adjoined the stabilizing link. Mr. Hall assumed in the initial design of the strut assembly that the main force acting on the link would not exceed that caused by a lateral acceleration of one "g". The links that broke should have withstood this force.

Mr. Hall's solution to the problem was to: 1) straighten out the stabilizing link in order to eliminate the bending moment at the threaded rod; and 2) redesign the joint so that it would be capable of withstanding three times the original design load. To accomplish this modification, however, Mr. Hall had to flatten the left exhaust duct on his cars.

NEW SPOILER SPOILS CHAPARRAL 2E DEBUT

Bridgehampton, N.Y. Sept. 18 - The spoiler on the new Chaparral 2E more than lived up to its name in this second round of the Can Am series.

In practice, a bolt fell off the device on Phil Hill's car, dropped down into the bodywork and onto a tire, causing it to blow, and the car slewed off the course at turn 11 and Hill trudged back to the pits.

Hall offered the ex-world champ his own car "to get some practice in" and out went Hill again. After five tours of the track a bolt fell off the spoiler on Hall's car (Hill driving), dropped down into the bodywork and onto a tire, causing it to blow. The car slewed off the course at turn 11 and parked right next to the first car.

Then, with hill's the only car capable of proper repair, Hall withdrew his pole-sitting 2E and Hill began a classic chase of eventual winner Dan Gurney.

For 50 laps they were within fractions of a second of each other until the spoiler on the Chaparral stuck in the "brake" position and Hill dropped back to finish fourth.

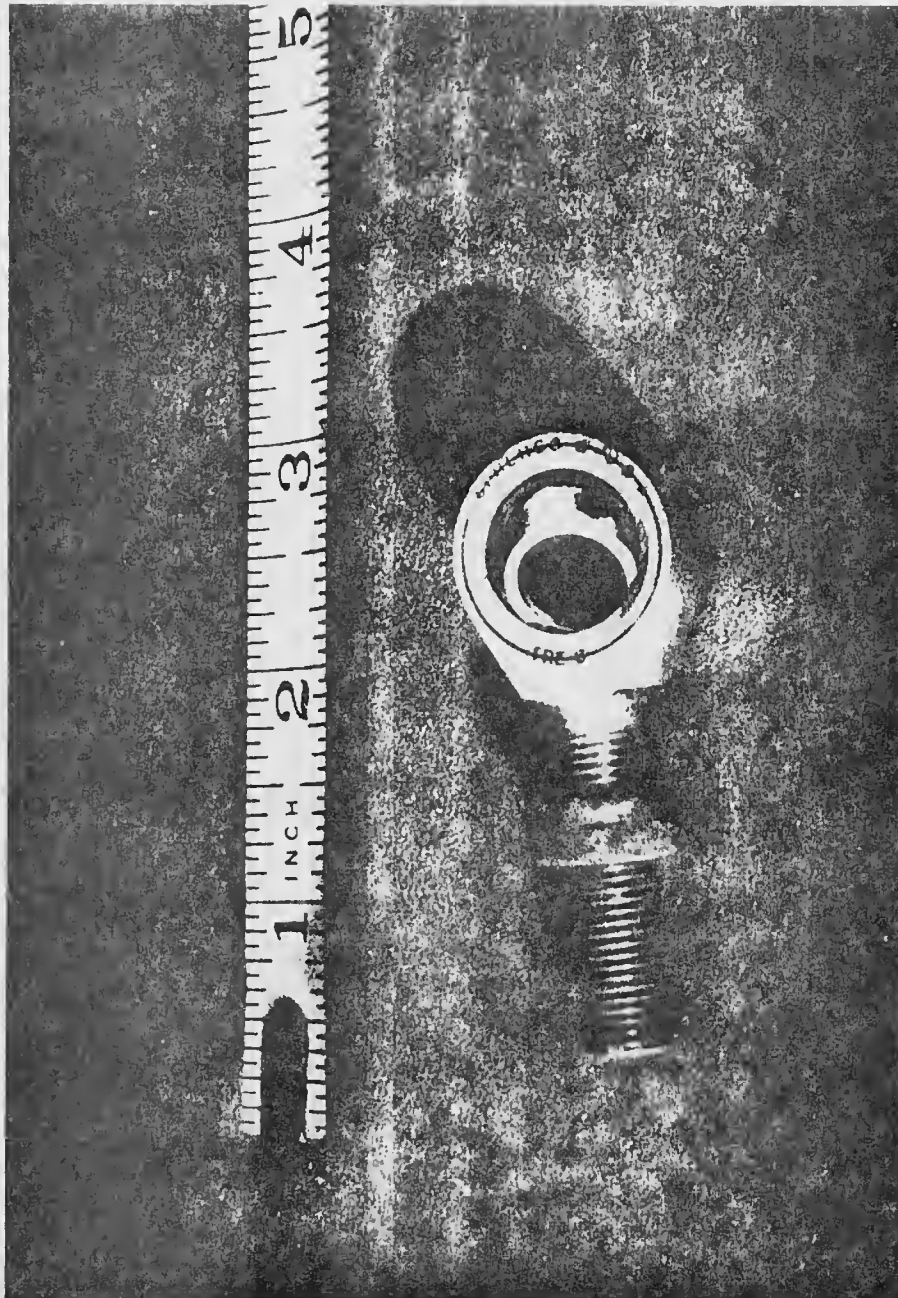


Exhibit 2b. Ball joint of the type that failed on the Chaparral stabilizing link.

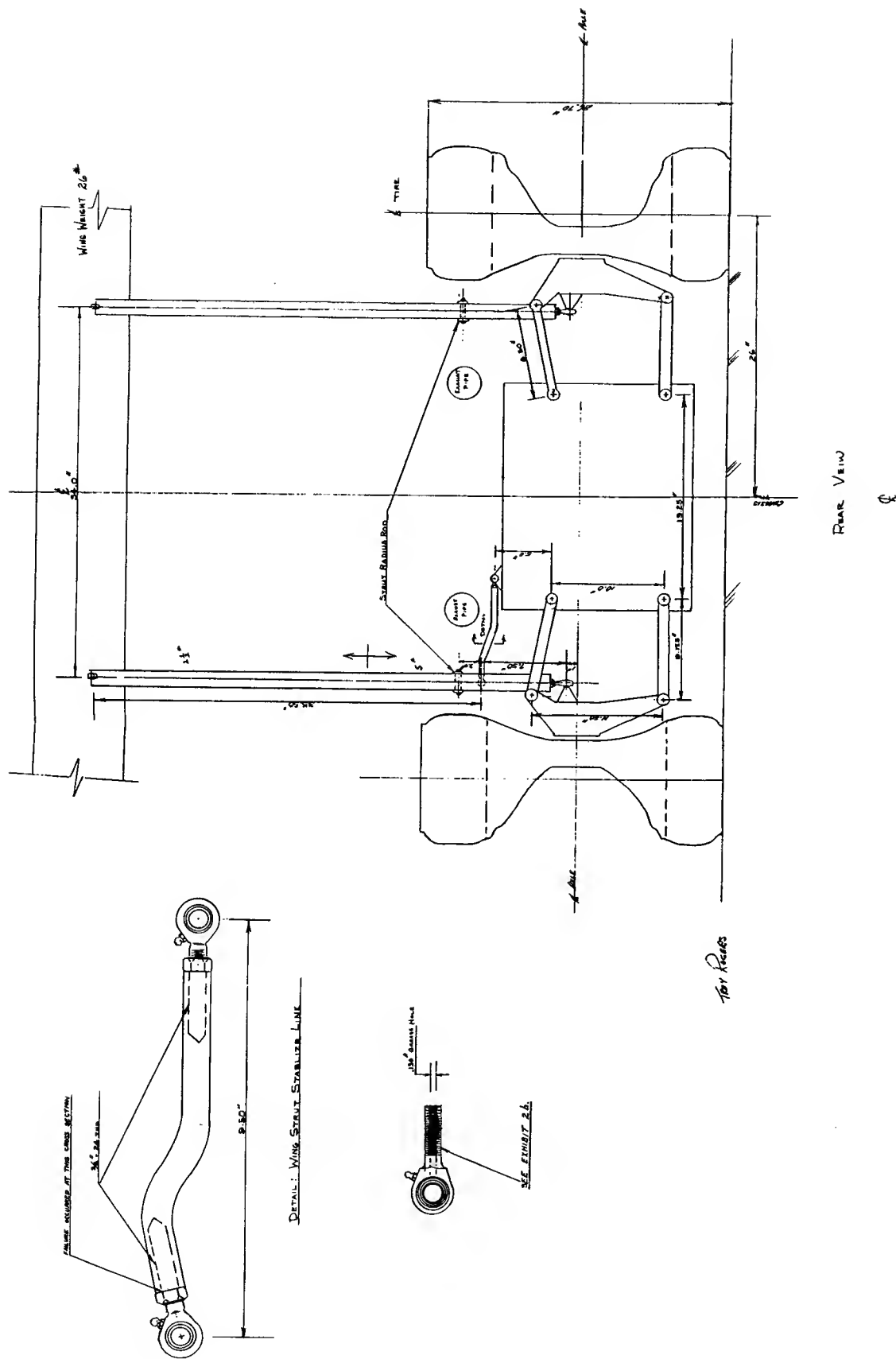


Exhibit 2a. Chaparral wing support diagram.